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The AUSTRALIAN URANIUM SITUATION: REALITY OR MIRAGE?

By

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Introduction

It is my privilege to present the paper on the uranium market at this year's Petroleum and Mineral Review Conference. My talk will be concerned with the projection of market changes as they arise from the interaction of nuclear power growth, uranium production economics, inventories and new ways of utility thinking.

The paper has three main parts. The first offers a retrospective look at the present condition of the uranium market and how it has come about. The second provides an outlook for the behavior of the market to 1996, as it appears plausible from current knowledge. The third part discusses briefly the chief implications for the Australian uranium industry, as I see them.

This paper is based on one of the most extensive data bases on the commercial nuclear industry in existence today, but it also contains personal judgment. Because human knowledge, particularly of the future, is quite imperfect, my views must remain open to re-interpretation as and when new evidence comes to light.

The uranium industry has been for some time in the process of change. The steep growth path predicted only a few years ago did not materialize. Indeed, the slow growth of nuclear generating capacity has reduced expected as well as real uranium demand, exacerbating the traditional excess of supply over consumption.

In addition, the nuclear power program is still experiencing attrition. Since 1975, eighty nuclear units have been cancelled in the USA. Cancellations amounted to 23 GWe in 1982, representing one-fifth of the US nuclear capacity projected for 1990. Completion of new nuclear power stations takes place much slower than expected. Of the 189 plants under construction and one order today, 158 are delayed and 30 have been indefinitely deferred. The combined effect of these factors has led to larger and larger inventories. Uranium stocks today have reached approximately 440 million pounds U_3O_8, representing more than 5 years of forward consumption.

Rising interest rates, inflation, falling electricity demand, and extended nuclear construction schedules have caused financial strain for the utility industry worldwide. To alleviate the pressure, utilities began to sell surplus inventories and deferred longer-term uranium purchasing decisions. Despite the chilly environment, world nuclear power capacity is anticipated to grow at a rate of 5 to 6 percent per year, mainly as a result of the construction backlog from orders placed several years ago.

The traditional industry practice of purchasing uranium supplies under long-term contracts has caused market saturation well ahead of delivery dates. Uranium requirements for the years 1987, 1990 and 1996 are estimated to be already under contract to the extent of 70 percent, 62 percent, and 40 percent, respectively. The available market is represented by the remainder.

Nuclear Power Growth

Figures 1 and 2 represent Nuexco's latest published forecast of nuclear power growth for the world outside communist areas (WOCA). Nuclear generating capacity will increase from 146 GWe in 1982 to 370 GWe in 1996, representing a growth rate of 5.8 percent per year from 1984. Installation of nuclear capacity is not anticipated to occur at the same rate everywhere. There are distinct regional differences.

In the USA, the nuclear capacity will reach a plateau, as no sustained growth is expected to occur. Even if utilities were to place new plant orders by 1984-85, they would not affect the forecast because of the ongoing attrition through cancellation of nuclear power stations and their long lead times of 12 years or more.

The European nuclear program is expected to increase by a factor of 2.2, and Far East capacity may grow by a factor of 2.6. Overall, Nuexco foresees a doubling of capacity by 1996 from 1984 levels.

In developing a picture of the uranium market, the increase in nuclear power generating capacity over time is only one factor among many. Its growth rate of almost 6 percent per year is deceptively high. Taken by itself, it could lead to overoptimistic assumptions unless circumscribed by the other factors.

Reactor Delays and Deferrals

When comparing published latest estimates (December 1982) of commercial operating dates (COD) of the 189 nuclear power stations under construction and on order with the enrichment service contracts for the same units, wide discrepancies have been observed. Thus, the published completion dates require serious further revision. On average, published completion dates will suffer a delay of at least 2 years. In Europe and the Far East the average delay is 1.5 years per unit; in North America, 2.5 years per unit. Thirty nuclear plants are

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considered as indefinitely deferred, of which 10 are located in Europe and 19 in North America.

Uranium Consumption

Estimates of future uranium consumption follow from the nuclear capacity forecasts, taking into account nuclear plant and fuel characteristics as well as fuel cycle requirements. Consumption is defined as the amount of uranium a power plant needs in the fuel cycle pipeline to run its reactor for one year. Consumption is therefore not to be equated with demand in market terms.

Uranium consumption is estimated to double during the forecast period, growing from 63 million pounds in 1982 to 128 million pounds of U_3O_8 in 1996. Figure 3 and 4 show details. The estimated growth rate is 3.4 percent per year from 1984. In the USA, consumption will be largely stagnant from 1984 onwards, averaging 35 million pounds of U_3O_8 per year. In contrast, Europe shows an increase of 63 percent. The consumption in the Far East is estimated to double over the period. Worldwide consumption is likely to increase by slightly more than 50 percent over the next 13 years.

Uranium Production

The bulk of world uranium supply is produced in seven major producing regions: Australia (holding the largest known uranium resources), Canada, Central Africa, France, Namibia, South Africa and the USA. In the early history of uranium mining, uranium was produced from small mines with only several hundred thousand pounds of yearly capacity or as a by-product from gold-mining operations. Since the discovery of large deposits in Namibia, Canada and Australia, the uranium supply industry has been undergoing significant changes towards maturity. Progressively, small, higher-cost producers are being displaced by those who can offer substantial economies of scale from large operations. Reduced demand for uranium is accelerating the process. As a result, it is expected that mine closures in the USA will reduce US production by about 50 percent, Central Africa's production may be curtailed by 30 percent, and projects in Australia and Canada will be deferred or even cancelled. Consequently, worldwide uranium production will fall from 112 million pounds in 1982 to 95 million pounds in 1994, stabilizing between 100 and 106 million pounds per year from 1985 onwards. Because Australian and Canadian production are no longer considered essential for the supply of future uranium demand, contrary to the view which had prevailed as recently as 1979, only producers who can effectively displace production elsewhere will enter the market or expand. Figures 5 and 6 provide details of Nuexco's forecast of uranium production to 1996. Three observations may help to clarify this forecast.

1. Canadian production will expand at Elliot Lake and Key Lake, but operations in Eastern Canada are assumed to decline from 1990 onwards.

2. Market shares between most major producing regions remain more or less constant because many operations must be regarded as "captive" to consumers.

3. Competition between Australia and Canada is assumed to be resolved in Canada's favor until 1990, due to Canada's proximity to the US market, where most of the unfilled demand will occur during the 1980s.

Figures 5 and 6 illustrate that uranium production is not a fast-growing industry; in fact, investors are withdrawing, as the decisions of several major oil companies have recently shown. Aware of these changes, producers are concerned, although their perceptions differ.

1. US producers believe that they will be displaced by lower-cost producers from Canada and Australia.

2. West Canadian companies and their Australian counterparts who seek to initiate projects fear that continuing low prices will preclude market entry or the recovery of investment costs.

3. Australian producers are concerned that they will be left without adequate government policy support in an increasingly competitive market.

4. Some producers are concerned about the inventories held by national entities with weak nuclear programs, as this surplus may be offered in the market at depressed prices.

5. Many producers are concerned about the risk of their long-term prices becoming tied to the spot price, which may display even more volatile behavior in the future. This maturing process, wherein high-cost operations are phased out and replaced by large lower-cost operations, brings about new shifts of buyer attention, initially towards Canada and later in favor of Australia.

During this transition, production will continue to exceed consumption and the buildup of inventories will persist. Uranium surplus stocks will continue to be redistributed through the secondary market until the majority of users are content with their individual positions. The secondary market will partly suppress the need of users to enter into long-term supply contracts. Once redistribution has occurred, uranium users will return to their traditional method of purchasing ura-

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nium through long-term contracts with primary producers. Consumers run the risk, however, that at that time insufficient production capacity may be available to meet their needs.

Uranium Inventories

The long-term mismatch of consumption with production has resulted in large uranium stocks in the hands of consumers and producers. Total world inventories in all stages of the fuel cycle are estimated to contain the equivalent of 440 million pounds of U_3O_8. Because existing supply contracts make it imperative for users to purchase uranium in excess of consumption, inventories are expected to grow until 1988, and only then decline slowly. Figure 7 shows the forecast of world inventories to 1996. The two nations with the largest inventories are France and Japan, who together hold one-third of the world inventory today.

Figure 7 also identifies the level of desirable inventory holdings, taking into account that the criteria for what is desirable vary from country to country. By assumption, these have been taken for the US at 1.5 years of consumption; 3 years for Europe; 5 years for the Far East; and 3 years for "other nations." Whilst inventories in the US are expected to fall, most of the excess inventories will accumulate outside the US.

As a measure of size, the total quantity of uranium stocks is not a valid yardstick. Only when inventories are expressed as a ratio of estimated consumption (relative inventory) are they seen in perspective. Figure 8 depicts relative inventories over the forecast period. Total free world (WOCA) inventories are estimated to fall from 5 years forward consumption in 1982 to 3.5 years of consumption in 1996. Large excess inventories affect the market in two ways: by tempering the propensity of utilities to enter into long-term contracts, and by destablizing prices. Information on inventory build-up and redistribution, if monitored effectively, may provide the industry with an additional tool to assess "real" as distinct from "perceived" uranium demand.

Unfilled Requirements

Unfilled requirements are the quantities of uranium needed by utilities for consumption which have not yet been purchased. The forecast for unfilled requirements between 1987 and 1996 is shown in Figure 9. The aggregate quantity amounts to 390 million pounds of U_3O_8, which constitutes the total available market over the period. Until 1990, the US requirement will dominate in the market, while unfilled requirements outside the US are expected to grow slower on account of higher market saturation existing in Europe and the Far East. In 1990, total unfilled requirements are equally divided between US and non-US utilities, but from then on US requirements will decline in dominance compared with the faster growing market outside the USA.

If utilities were to cover from excess inventories all of the 1987 unfilled requirements of 20 million pounds, the surplus at that time would be reduced by a mere 10 percent. In addition, a large portion of existing production capacity is awaiting future commitment. It is, therefore, not unduly pessimistic to project world oversupply conditions to 1990 at least. Unfilled requirements may be filled from a mix of three sources:

1. inventories;
2. existing, uncommitted capacity;
3. new capacity.

As domestic production is declining in the USA, but unfilled requirements are increasing, US utilities will rely to a larger degree on foreign sources, buying initially from Canada and later, assuming some reassuring experiences, increasingly from Australia.

Supply and Consumption

Existing production capacity, including its uncommitted portion, is inadequate to meet uranium consumption from 1988 onwards. To satisfy requirements, uranium consumers will rely on two sources of supply for the balance: inventories and new projects. Figure 12 expresses Nuexco's estimate of how these three sources satisfy consumption needs. The graph may engender a mild optimism regarding future market opportunities, but one must remain mindful of the fact that an excess inventory of 220 million pounds of U_3O_8 overshadows the market during the forecast period.

Implications for the Australian Industry

The uranium market on its journey to maturity is moving towards a new equilibrium. To reach it, production must fall sufficiently below consumption to draw down inventories. This adjustment causes stress for individual producers. Those who only marginally recover their cost at current prices are threatened. Those who wish to add substantial capacity may face long deferrals depending on their position on the supply curve. The tension will be resolved by the market. Unfilled requirements will operate as the driving variable in the process of price determination. What are the consequences for the Australian uranium industry? Several large projects are in an advanced stage of

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technical readiness. As has been demonstrated, the market is not large enough over the next 5 to 7 years to accommodate them all at the same time. Their individual opportunities are determined by:

1. The economic viability of each project under current market conditions;
2. Their visibility in the marketplace as valid, alternate sources of supply;
3. The decision of consumers to entrust long-term supply to an Australian producer.

Inventory redistribution apart, Australian producers face strong competition from Canada and South Africa for a share of the relatively small market constituted by the unfilled requirements. Nevertheless, opportunities for Australian suppliers exist simply because not every utility wishes to rely too heavily on these two sources alone, provided all other considerations are equal. Eventually, those producers with the highest customer appeal in terms of price, government commitment, political stability, foreign equity, delivery schedule and production economics will make the grade.

Although opportunities for launching a major project before 1990 have become more remote, projects whose start-up was planned for the 1988-1990 time slot should continue to maintain economic vigilance by adjusting their projects to the market and by keeping user awareness high. Consumer confidence, once lost, can only be regained at considerable expense of time, money and effort.

Australia can turn the restructuring of the uranium market into a long-term advantage by remaining a flexible, serious and active participant. Opportunities to earn revenues from uranium are still available, although the time horizon for new mines is shifting more than expected into the future. This increase in lead times makes the road from discovery to production more arduous. For developers who can last the distance, the future still looks good.

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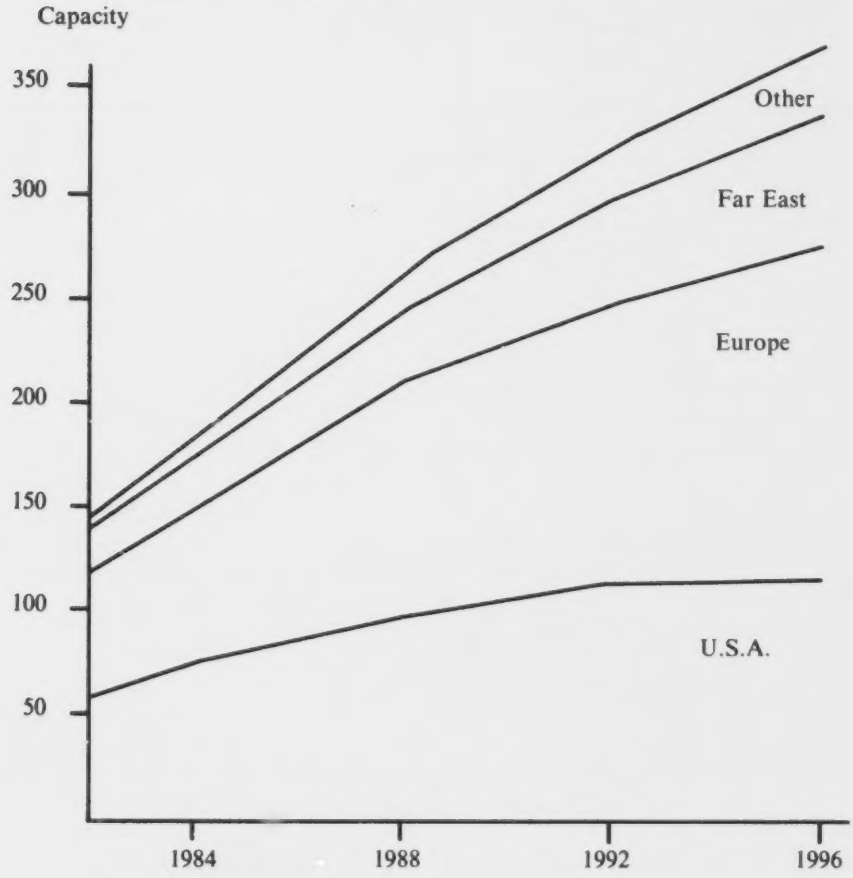
Figure 1

FORECAST OF FREE WORLD NUCLEAR CAPACITY (GWe)



Source: Nuexco — 12/82

Figure 2

FORECAST OF FREE WORLD NUCLEAR CAPACITY (GWe)

	1982	1984	1988	1992	1996
U.S.A.	58.0	71.8	96.7	112.9	112.9
Europe	59.6	73.4	110.3	133.3	162.2
Far East	20.7	23.7	36.3	49.2	62.2
Other	8.0	10.3	16.7	26.0	33.2
Total	146.3	179.2	260.0	321.4	370.5

Source: Nuexco — 12/82

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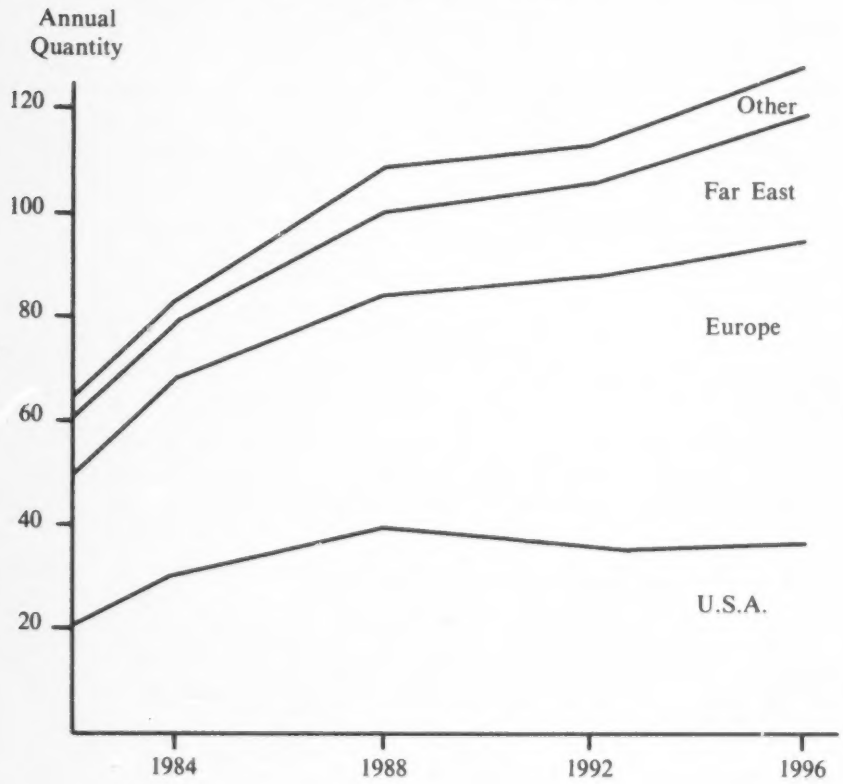
Figure 3

FORECAST OF FREE WORLD APPARENT FUTURE CONSUMPTION
(Millions of Pounds U_3O_8)



Source: Nuexco — 12/82

Figure 4

FORECAST OF FREE WORLD APPARENT FUTURE CONSUMPTION
(Millions of Pounds U_3O_8)

	1982	1984	1988	1992	1996
U.S.A.	20.9	30.7	39.4	35.0	35.0
Europe	27.9	36.5	44.9	51.5	59.6
Far East	10.8	11.1	15.7	16.9	22.9
Other	3.8	4.6	6.9	8.3	10.3
Total	63.4	82.9	106.9	111.7	127.8

Source: Nuexco — 12/82

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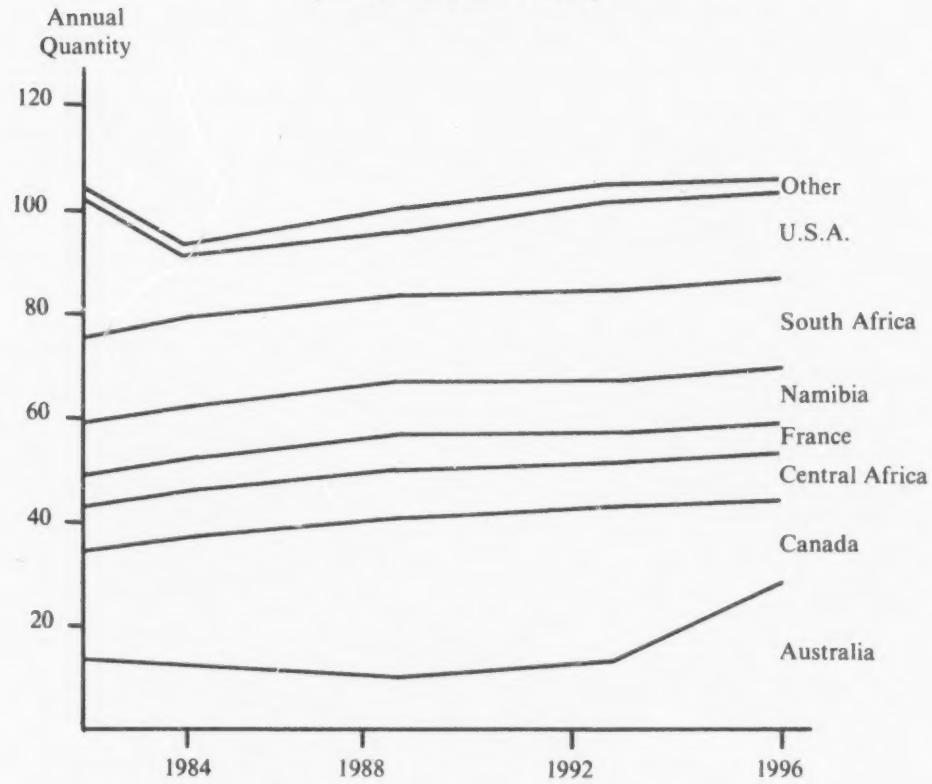
Figure 5

FORECAST OF FREE WORLD URANIUM PRODUCTION
(Millions of Pounds U_3O_8)



Source: Nuexco — 12/82

Figure 6

FORECAST OF FREE WORLD URANIUM PRODUCTION
(Millions of Pounds U_3O_8)

	1982	1984	1988	1992	1996
Australia	13.1	12.3	10.0	12.6	27.6
Canada	18.5	24.5	31.0	28.8	16.7
Central Africa	11.7	9.0	9.0	9.0	9.0
Namibia	10.5	10.0	10.0	10.0	10.0
South Africa	15.6	17.2	17.2	17.5	17.5
U.S.A.	25.9	12.0	12.4	15.9	15.4
Other Nations	2.0	3.0	4.2	3.5	3.5
Total	103.2	94.0	99.8	104.3	105.6

Source: Nuexco — 12/82

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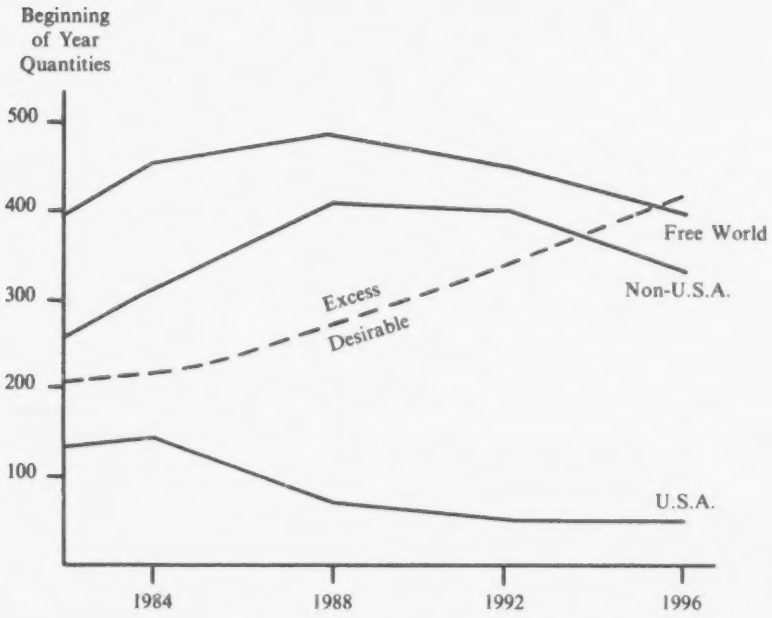
Figure 7

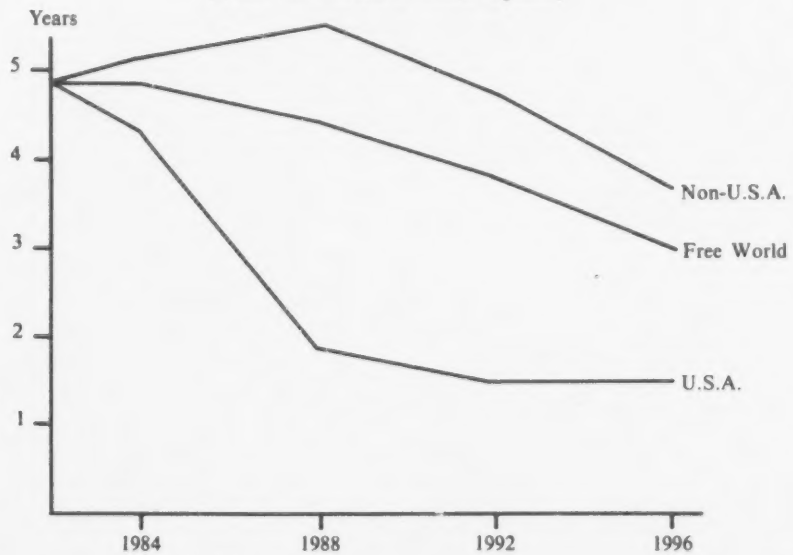
FORECAST OF FREE WORLD INVENTORIES
(Millions of Pounds U_3O_8)



Source: Nuexco — 12/82

Figure 8

FORECAST OF RELATIVE INVENTORIES
(Years of Forward Consumption)



Source: Nuexco — 12/82

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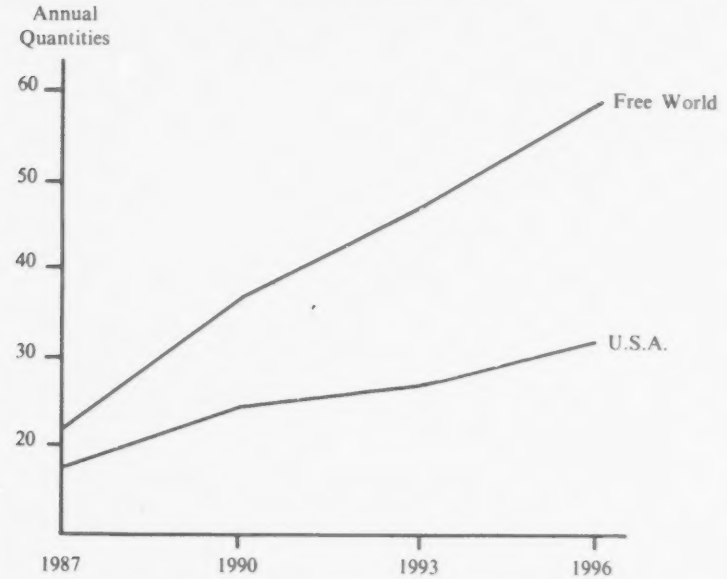
Figure 9

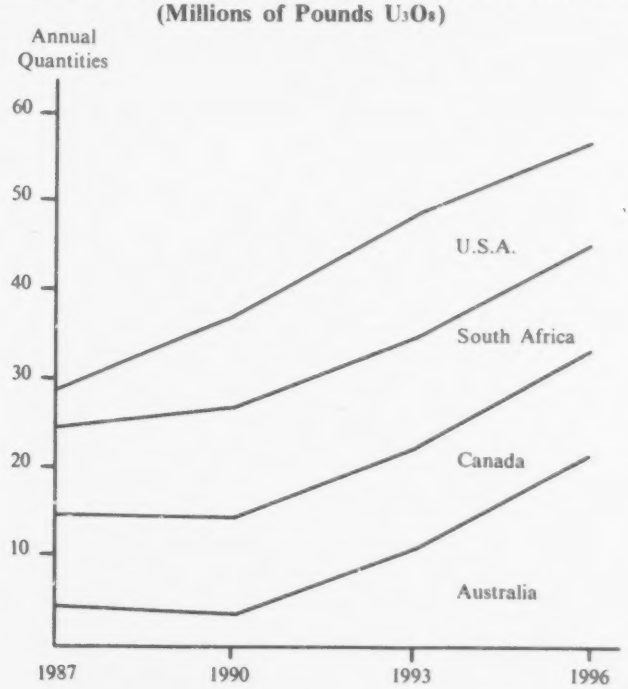
FORECAST OF FREE WORLD UNFILLED REQUIREMENTS
(Millions of Pounds U_3O_8)



Source: Nuexco — 12/82

Figure 10

FORECAST OF FREE WORLD UNCOMMITTED PRODUCTION
(Millions of Pounds U_3O_8)



Source: Nuexco — 12/82

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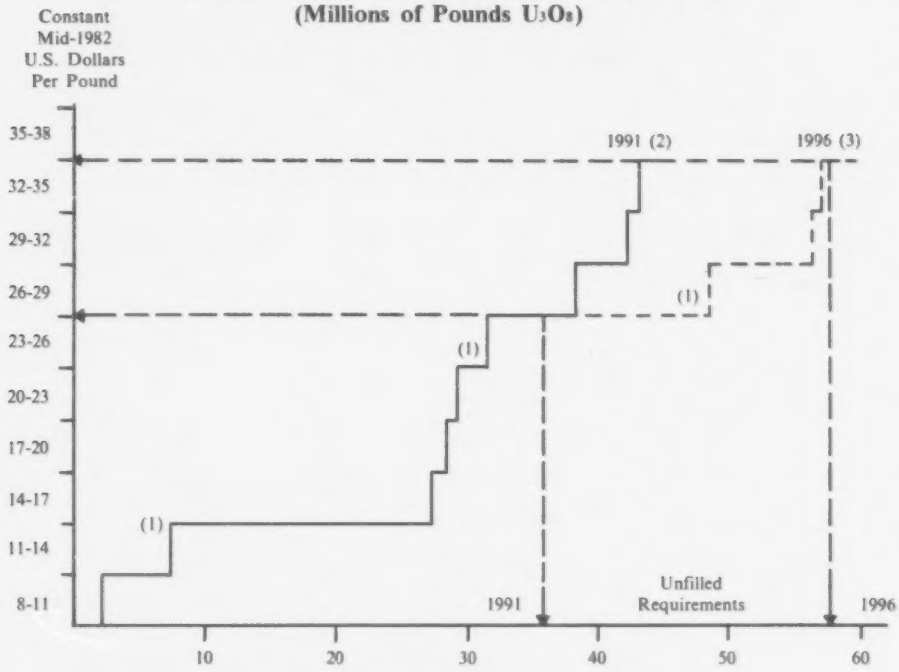
Figure 11

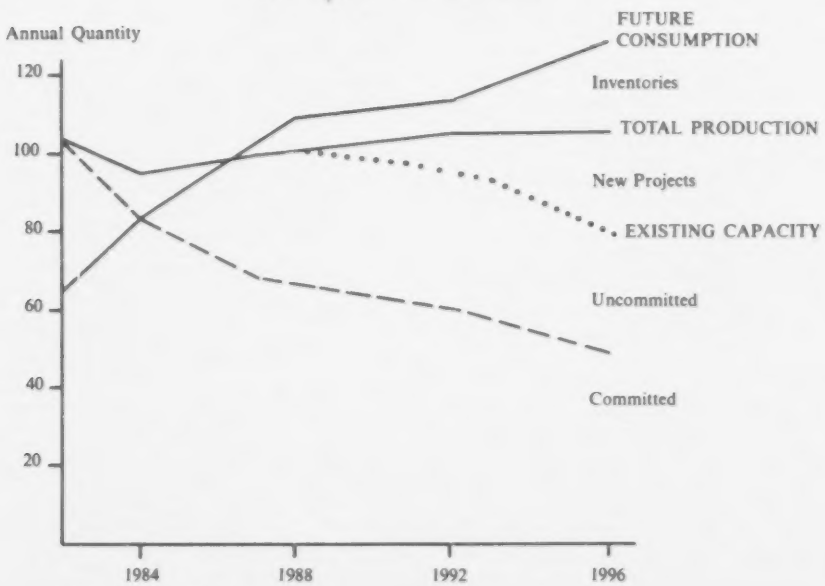
FORECAST OF UNCOMMITTED PRODUCTION
(Millions of Pounds U_3O_8)



[1]Cost Bands of Australian Production
[2]Does not include New Australian Developments
[3]Includes 15.6 million pounds from New Australian Developments

Figure 12

SUPPLY VS. CONSUMPTION
(Millions of Pounds U_3O_8)



Source: Nuexco — 12/82

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THE URANIUM MARKET:
A POSSIBLE TIME OF TRANSITION FOR SOUTHERN AFRICA

By

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Vice President
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THE URANIUM MARKET: A POSSIBLE TIME OF TRANSITION FOR SOUTHERN AFRICA

By: James E. Vaughan
Vice President
Nuexco

Introduction

Before getting into the subject at hand, let me say a few words about Nuexco, to serve as an introduction and as a basis for the credibility of my remarks.

Nuexco is a privately held US corporation. Our headquarters are in Menlo Park, California. We also have two other offices in the US and one in Europe, near Geneva, where I work. We have representatives in South Africa, Australia, Japan and Taiwan. Altogether, we have 35 full-time employees and representatives whose only task it is to follow the nuclear fuel market. Our principal activities are:

1. Publication of the Monthly Report on the Nuclear Fuel Market.
2. Serving as a broker in nuclear fuel transactions.
3. Providing consulting services on nuclear fuel matters.

Our Monthly Report is received by virtually every participant in the uranium market; users, producers and observers of the market, such as financial institutions. I have often heard it referred to as the "Platt's Oilgram" of uranium. The Monthly Report features supply and demand data for the entire front end of the fuel cycle, and pricing information, including the "Exchange Value," which is a measure of the price of uranium, as of the last day of each month.

Summary

I will begin by giving you a summary of the brief history of the commercial uranium market. Next, I will discuss our view of the future rate of introduction of nuclear electric generating capacity in the free world (world outside communist areas, or "WOCA"). From this data, a projection of world uranium consumption (i.e., requirements) can be derived. Combining this with Nuexco's data base of the commitments and inventory levels of individual buyers, we can compute unfilled requirements. This approximates the market that South Africa and other uranium producers have available to them.

We can do a similar analysis for the production side. We can estimate world production years into the future, and, combined with Nuexco's data base of producers' commitments to sell, we can derive uncommitted supply for free world producers, including South Africa. This gives us a picture of who will be competing to fill the unfilled requirements, with particular emphasis on the impact on South African producers. Specifically, we see a market for the rest of this decade in which the majority of unfilled requirements are in the United States. American purchasers have become more and more focused on making uranium purchases with prices keyed to spot market, even if associated with long-term contracts. South African producers have relied primarily on long-term contracts with prices not directly related to spot market. Also, there has been almost no direct business done between South African producers and US utilities. In the market which we foresee for the rest of the 1980s, it might be useful for these two divergent groups to find a common ground on which business can be transacted.

We then turn to recent history and examine spot market supply and demand and price. Particular attention is paid to recent inventory sales. The focus is then shifted to the next two years, 1983 and 1984, when inventory sellers are expected to continue to influence the market.

We then look at other matters of importance in the 1980s, including the possibility of significant uranium stockpiling by South African producers and the business environment in which US utilities operate.

Prices

It should be no secret to anyone at all familiar with the uranium business that spot prices have come down substantially from their lofty heights in the late 1970s. Table 1 lists Nuexco's Exchange Value from 1968 to the present. Uranium prices were fairly flat since the onset of the commercial uranium business in the late 1960s, at $6 to $7 per pound U_3O_8, until early 1974 when they started an exponential rise to more than $40 per pound in early 1976. Prices stayed on a high plateau for about four years, then, at the end of 1979, began to fall rapidly. The Exchange Value went all the way down to $17 in September 1982, before rebounding to the current level of $22.25. A senior official in the South African mining industry stated publicly late last year that the $17 low point marked the lowest real price of uranium in history, when compared to the average cost of producing a pound of uranium by South African Chamber of Mines producers. The data tends to confirm this. The Exchange

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Value averaged about $6 per pound in 1972, and the 1972 average declared working cost by Chamber of Mines producers was 8.79 rand per metric ton of ore milled. The average working cost for 1982 was about 47.2 rand per ton.

Multiplying the Exchange Value ratio (22.25/6) by the working cost ratio (8.79/47.2) and by the change in Exchange rate between the dollar and the rand (1.40) yields a ratio of almost unity. Thus, it is arguable that real spot prices viewed by South African producers are essentially the same now, with the Nuexco Exchange Value at $22.25 per pound, as they were in 1972. Thus, it follows that when the Exchange Value was $17 last September, spot prices were the lowest ever from a South African standpoint. Uranium mining in South Africa has generally been a profitable venture, both in the early 1970s and today; however, it should be noted that most of South Africa's production is now sold under long-term contracts which on the whole are currently bringing above spot market prices.

The illustration in the previous paragraph dramatizes the impact of inflation on the changing fortunes of the uranium producer over the past several years. Putting it another way, the Exchange Value reached $40 per pound in mid-1976. The US Producer Price Index for Industrial Commodities (1967 = 100) has moved from 182.4 in 1976 to about 310 (on a preliminary basis) in 1982. Thus, $40 in 1976 is worth about $68 in current purchasing power, using the US Producer Price Index for Adjustment. Thus, the real price of uranium fell from $68 in mid-1976 to $17 in September 1982, a factor of four! The recent recovery of the Exchange Value to $22.25 has reduced the magnitude of the slide from 1976 to a factor of three.

We see little likelihood of a substantial further recovery of spot prices in the near term. Two basic reasons argue against significantly higher near-term prices. First is the continued existence of a strong secondary market, where holders of inventory are selling material back into the market. Second is a chronic imbalance between consumption and production, which will result in the world's inventory position increasing further over the next few years.

Uranium Consumption

Table 2 is Nuexco's forecast of free world (WOCA) installed nuclear electric generating capacity. This is the logical place to start a market analysis since the growth of uranium consumption is primarily dependent upon the growth of nuclear power generation. The growth of nuclear power is analyzed by Nuexco on a country-by-country basis, with attention to probable economics, energy consumption, national energy alternatives, the financial condition of the utilities, licensing considerations, etc. The analysis of generating capacity serves as the basis for calculating future uranium consumption. We expect continued growth of installed nuclear capacity into the 1990s, from 146 gigawatts (GWe) in 1982, to 370 GWe in 1996, a compound increase of about seven percent per year. In a world where 2.8 percent long-term electrical load growth is generally expected, this is quite impressive, albeit not as high as was once anticipated. In the US, we expect to complete most of the plants now under construction or awaiting construction permits, but no new ones. We do expect, however, to see continued growth in Europe and the Far East.

Table 3 represents Nuexco's estimate of "apparent future consumption" of uranium. As used by Nuexco, the term "consumption" refers to a calculation of the uranium which will be, in effect, consumed annually in the operation of nuclear power plants, with time allowed to proceed through the fuel cycle. The methodology of this calculation has been described frequently in the Nuexco Monthly Report, most recently in Report Number 173 dated January 1983. However, it is most important to point out that apparent future consumption is *not* the same as unfilled requirements, since unfilled requirements depend on inventories, existing commitments for future deliveries, and individual utility procurement practices. Consumption on a worldwide basis is forecast by Nuexco to increase from 63 million pounds in 1982 to 128 million pounds in 1996, a compound growth rate of about five percent per year.

Table 4 shows Nuexco's forecast of free world unfilled requirements. This estimate is derived from the apparent future consumption estimate, adjusted by Nuexco's data base of existing inventories and existing commitments for future deliveries on a utility-by-utility basis. The United States tends to dominate the unfilled requirements picture through the end of the decade, with more than two-thirds each year from 1984 through 1990. Unfilled requirements in the Far East are almost negligible through 1990. Unfilled requirements in Europe do not become important until 1988.

The groundrules for which the unfilled requirements calculations were carried out include the assumption that, for the individual utility, material carried in inventory will be used to fill requirements if there are no

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existing commitments to receive uranium from suppliers. In other words, it was assumed that inventories would be drawn down to zero prior to triggering an entry in unfilled requirements. However, we believe that most utilities will elect to carry some inventory to bolster security of supply. Thus, we performed a sensitivity analysis to determine whether the results in Table 4 would change substantially if we imposed minimum forward inventory constraints. This minimum forward inventory would be in addition to the pipeline lead-times already built into the apparent future consumption algorithm (that is, 24 months for first cores and 18 months for reloads). The following minimum inventory levels were assumed: United States, 1.5 years; Europe, 3.0 years; Far East, 5.0 years. The results of this analysis are outlined in Tables 5, 6 and 7 for the US, Europe and the Far East, respectively. It is seen that imposing these additional constraints does not change the result substantially until 1988. Table 5 shows that in 1988, additional unfilled demand is created in the US. Table 6 shows additional demand in Europe at about the same time and in about the same quantities. Table 7 indicates that Far East forward inventories remain above six years during the entire time period of this analysis. A fourth calculation was performed, and the results listed in Table 8, assuming that European utilities will be satisfied with two years forward inventory, in which case no additional demand is created in Europe by these constraints until 1990.

This sensitivity analysis was intended to examine on a macroscopic scale the probable consequences of a wholesale regional desire for a certain inventory level. It does not attempt to look at the behavior of individual utilities, and as such, its usefulness is somewhat limited. Its only real conclusion is that if European utilities, as a whole, will want to keep uranium inventories of two to three years forward consumption and US utilities keep 18 months forward consumption, the conclusions outlined in the remainder of this paper are probably reasonable. That is to say, most unfilled demand will continue to be in the US for the balance of the decade.

Uranium Production

We are now ready to take a look at a production forecast. Table 9 contains Nuexco's forecast of WOCA uranium production. WOCA consumption and inventory information is listed on the same Table for reference. It is seen that world production is expected to fall between 1982 and 1983, mainly due to cutbacks in the US. Production then rises slightly until 1986, when it levels off for a few years at about 100 million pounds U_3O_8 annually.

This estimate, together with Nuexco's data base of existing delivery commitments, is then used to estimate uncommitted production. Table 10 contains Nuexco's estimate of WOCA uncommitted production, with southern Africa shown separately for comparison.

The production forecast in Table 9 is based on the following general groundrules:

1. African production will generally continue at about its present level for the remainder of the decade.
2. US production will continue to decrease for the next few years.
3. Major new Australian and Canadian projects will suffer continued delays, except Key Lake and Collins Bay in Canada.

Long-term Market Expectations

We are now ready to look at the intermediate to long-term outlook for supply and demand. By supply and demand, we are here referring to uncommitted production and unfilled requirements, as we discussed them above. In actuality, however, real demand may be different; for example, real demand may be higher because of greater than anticipated purchasing for inventory. Real supply may also be different. It may be higher, for example, because of higher than anticipated production in the US, or it may be lower because of decisions by South African producers to stockpile rather than sell into the available market. Table 11 compares uncommitted production with unfilled requirements. South African uncommitted production is listed separately. One thing is immediately apparent from Table 11; most of the unfilled requirements in the 1980s are US. If our estimates are reasonably accurate, the South African producer will be looking at a somewhat unfamiliar future, because South African uranium has generally gone to non-US buyers. There have been some exceptions; some uranium from this region has found its way into the US through fuel fabricators, other producers, and trading companies, but little has gone directly to US utilities. There were probably a number of good reasons for this. There has been a great deal of litigation going on in the US over the past several years (some is still going on) that the South African producers were anxious to avoid. On the other hand, from the US utilities' standpoint, they have viewed the US as being self-sufficient in uranium until recently, and if imports were sought at all by US utilities, they were generally

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sought from Canada or, to a lesser extent, Australia. In addition, there was, and unfortunately still is, an institutional bias within most US utilities against contracting for South African supply. I emphasize that the bias is institutional because individual utility fuel managers generally recognize South Africa's exemplary delivery record and high quality product. To understand the reasons for this problem, one has to examine the open environment in which the US utility generally operates. It has been described as a "goldfish bowl." As a result, US utility executives are constantly exposed to second-guessing, especially by regulatory agencies and the news media. Partially as a result of this situation, and as a consequence of their basic charter which is to supply reliable electric service, their business philosophy is usually one of risk avoidance.

Among the risks utilities, as institutions, tend to avoid is political controversy. Contracting directly with a South African company might be viewed by US utility executives as setting themselves up for criticism by regulators, shareholders and the media, not because of any questions of reliability, but simply for political reasons revolving around South Africa's racial policies as viewed by the US observer (albeit, admittedly, often through the polarized eyes of the US news media).

The data in Table 11 indicates it is quite possible that US users and South African producers will somehow be drawn together during this decade, either directly or, as before, indirectly because of the dominance of US unfilled requirements through 1990. It has been suggested that an alternative for the South African producers would be massive stockpiling of uranium, either in the form of concentrates, or in the form of slimes, to be recovered later (probably near the end of mine life). It has, at the same time, been suggested that the South African government would, in effect, pick up a large percentage of the cost of stockpiling, since annual operating losses from uranium production would be deductible from profits on gold sales. Thus, if uranium were not sold, its cost of production would have no associated revenue, and would thus offset gold revenues, since the two accounts are considered together for government tax and royalty purposes. The current S.A. government combined tax and royalty rate is about 65 percent of profits, so as long as gold production is reasonably profitable, the government would finance two-thirds of stockpiling costs. This reasoning would be fine if the government would go along with the idea; however, it has apparently been agreed that, for purposes of tax and royalty calculations, stockpiled uranium is to be valued at its cost of production. Thus, the government's subsidy would drop from two-thirds to near zero, so there appears to be no real tax advantage to stockpiling under those conditions.

There may be another advantage of stockpiling, at least for the near term. Most South African uranium is sold under long-term contracts with prices subject to annual negotiation. It is generally believed that these annual negotiations have in recent years yielded prices higher than the spot market. Selling new material at or near current spot market prices may be viewed by South African producers as inimical to their annual negotiations with their existing long-term buyers. Thus, we may expect some stockpiling of unsold production, at least until spot prices are more in line with the annually negotiated prices under long-term contracts, or until the size of the stockpile becomes burdensome. The extent to which the stockpile does become burdensome would, of course, depend rather importantly on the price of gold.

Near-term Market Expectations

Before we take a look at the next two years or so, it may be instructive to look at the last few years. We have already discussed the price slide which began in late 1979. Why did this happen? Part of the answer can be seen by comparing the size of the WOCA 1983 beginning-of-the-year commercial inventory, 438 million pounds U_3O_8, with the 1983 anticipated production, 90 million pounds. Uranium production has exceeded consumption every year since the inception of the commercial uranium market. Due to extensive delays and cancellations of nuclear power capacity, some of this inventory has found its way back into the market to compete with primary production in an already crowded market. The result was downward pressure on prices. This phenomenon reached something of a crisis in 1982 as shown in Table 12. The year 1981 ended with a near-term supply-demand ratio of about two. The terms supply and demand are somewhat more rigorous terms when used in a near-term sense, as compared to the longer-term discussion above. Near-term supply means the total of material actively being offered for sale and delivery within one year of the date in question. Near-term demand is material actively being sought for near-term delivery. During 1982, the supply-demand ratio gradually rose from 3.5 in January to 16 in June. There was a great deal of competition among inventory holders to make sales during 1982. At least nine separate entities

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sold quantities in excess of one million pounds U_3O_8 on the near-term market. On the demand side, there were a number of bargain hunters in the market from all over the world, utility and producer alike. Toward the end of 1982, many of the sellers in the market had accomplished their purposes and, having done so, withdrew from the market. Thus, the market began firming a bit. The supply-demand ratio went back down to more resonable levels.

Looking a year or two into the future, we see continued importance of inventory sellers. Some are still active in the market. Others are on the sidelines, either preparing to sell, or waiting to see if prices come up somewhat. There is also uncommitted production from producers which may find its way into the near-term market. With inventory redistribution likely to continue, it is difficult to see a mechanism for substantial price strengthening in the near term. We believe it will take at least a year or two for the inventory redistribution problem to be solved; that is, for inventory to pass from weak hands to strong. A great deal of this inventory has found its way into the hands of some US producers which have trimmed production and are instead buying on the spot market to deliver under existing contracts.

The Spot Market

We can now turn to a brief discussion of the spot market, and one of its barometers, the Nuexco Exchange Value. The spot market in the last 12 to 18 months has been relatively hectic. I say relatively, because the uranium market, as commodity markets go, has a fairly high time constant; it moves rather slowly. Referring back to Table 1, the market arguably began a business cycle back in the early 1970s and appears to be completing it about now. Given the long lead times in nuclear power, and the fact that uranium is a commodity with only that one use, this long business cycle should not be surprising. The spot market for uranium has traditionally been rather thin, with about 85 to 90 percent of annual production sold on a long-term basis.

Lately, however, the spot market volume has been picking up, especially with the rise of the secondary market for uranium (i.e., resale by inventory holders). Commodity market observers hasten to point out that this is quite normal as a market moves towards maturity. Spot market activity not only becomes important in and of itself, but it also tends to influence longer-term relationships by providing a reference price level, or perhaps the actual price for deliveries under long-term contracts. Things appear to be headed in this general direction in uranium. Not only are unusually large (by past standards) quantities of uranium trading on the spot market, but many new long-term contracts contain pricing formulas in some way related to the spot price, often specifically to the Exchange Value.

One factor pushing in the direction of increased importance of the spot market price is the business philosophy of the US utility, and the existence in the US of the so-called fuel adjustment clause. As we have discussed, the charter of the electric utility, namely reliable service, dictates a strategy of risk avoidance. This philosophy, in combination with the near-universality in the US of the fuel adjustment clause, results in an emphasis in the US on buying at spot market prices. If the utility buys uranium "below the market price," the benefits flow not to the company, but to the ratepayer, since fuel costs are generally passed through to customers under the fuel adjustment clause. This ratemaking clause was adopted almost everywhere in the US during the 1970s when the cost of all fuel was rapidly rising. However, an apparent corollary of this type of rate relief is the necessity to demonstrate that the utility is still being prudent and not paying above market price. If the utility fuel buyer pays "more than market price," he is at best embarrassed in front of his management. Even worse, the company may be called to task by the usually politically motivated regulatory authorities. Worst of all, we have seen cases where the utility shareholders have had to absorb any price differential above market. Thus, the utility policy of risk avoidance translates into a desire to buy fuel at market price. Who can criticize you for paying the going rate, whatever it is? As a result, US utilities now generally refuse to enter into contracts which might require them to pay more than market price. Thus, we now see many long-term uranium contracts under which all deliveries actually made are priced on the basis of some spot market indicator. Again, this has ample precedent in other commodity markets.

Security of supply has dropped to a lower level of importance in the US utility, the theory apparently being that, at some price, uranium can always be obtained, and under presently existing conditions, that cost can always be passed on to electricity users as long as it is "at market" or below. That phenomenon, together with the large existing US commercial inventories (to say nothing of the equally large US DOE strategic inventory) has at this time put security of supply concerns at a somewhat

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lower level of priority than price in the US.

This concludes my prepared remarks, except for a somewhat philosophical concluding statement. Market participants would do well to carefully study what observers like Nuexco say about the market, and carefully compare our views with other observers. At such time as we all appear to be saying the same thing, that is the time to engage the "theory of contrary opinion," and begin looking for reasons for why the crowd may be wrong. When all the experts are saying the same thing, all the people who listen to the experts are probably doing the same thing, and that is the time when interesting opportunities tend to develop for those who are alert enough to recognize them. This kind of philosophy usually works best near the bottom and near the top of business cycles.

Table 1

HISTORICAL NUEXCO EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	**22.25**									

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Table 2

NUCLEAR ELECTRIC GENERATING CAPACITY[1] [2]
(Thousands of MWe — Net)

BUYER GROUP	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
United States										
Reactors now operational	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0
Now under construction	0	6.4	13.8	20.4	29.1	34.4	38.7	44.0	51.7	53.8
Now on order/planned/future	0	0	0	0	0	0	0	0	0	0
US Subtotal	58.0	64.4	71.8	78.4	87.1	92.4	96.7	102.0	109.7	111.8
Europe										
Reactors now operational	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.4
Now under construction	5.1	13.7	18.9	27.9	37.5	48.3	55.8	59.6	63.5	63.5
Now on order/planned/future	0	0	0	0	0	0	0	1.3	2.5	9.4
Europe Subtotal	59.6	68.2	73.4	82.4	92.0	102.8	110.3	115.4	120.5	127.3
Far East[3]										
Reactors now operational	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7
Now under construction	0	0	3.0	5.8	9.6	11.8	14.5	16.3	16.3	17.2
Now on order/planned/future	0	0	0	0	0	0	1.1	2.7	5.7	8.7
Far East Subtotal	20.7	20.7	23.7	26.5	30.3	32.5	36.3	39.7	42.7	46.6
Other Free World[4]										
Reactors now operational	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Now under construction	0	0.9	2.3	4.3	6.4	7.7	8.7	10.7	12.5	13.4
Now on order/planned/future	0	0	0	0	0	0	0	1.2	1.8	2.7
Other Subtotal	8.0	8.9	10.3	12.3	14.4	15.7	16.7	19.9	22.3	24.1
FREE WORLD[4] TOTAL	146.3	162.2	179.2	199.6	223.8	243.4	260.0	277.0	295.2	309.8
Worldwide Breakdown by Status										
Reactors now operational	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.1
Now under construction	5.1	21.0	38.0	58.4	82.6	102.2	117.7	130.6	144.0	147.9
Now on order/planned/future	0	0	0	0	0	0	1.1	5.2	10.0	20.8

[1]Installed as of year end
[2]Uses Nuexco's estimates of commercial operating dates
[3]Japan, Korea, Taiwan, Philippines
[4]Excludes Bulgaria, Czechoslovakia, German Democratic Republic, Finland (two Russian reactors), Hungary, People's Republic of China, Poland, Romania, USSR

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Table 3

APPARENT FUTURE CONSUMPTION[1]
(Millions of Pounds U_3O_8)

BUYER GROUP	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
United States										
Reactors now operational	19.1	19.1	19.1	19.1	18.8	18.5	18.2	17.9	17.7	17.4
Now under construction	1.8	5.5	11.6	12.5	14.7	16.8	21.2	16.8	18.0	17.3
Now on order/planned/future	0	0	0	0	0	0	0	0	0	0
US Subtotal	20.9	24.6	30.7	31.6	33.5	35.3	39.4	34.7	35.7	34.7
Europe										
Reactors now operational	21.0	21.3	21.3	21.0	21.0	20.8	20.4	20.2	20.0	19.3
Now under construction	6.9	13.0	15.2	22.0	20.9	20.6	21.9	22.0	21.0	21.3
Now on order/planned/future	0	0	0	0	0	1.3	2.6	4.2	5.9	7.5
Europe Subtotal	27.9	34.3	36.5	43.0	41.9	42.7	44.9	46.4	46.9	48.1
Far East[2]										
Reactors now operational	7.6	7.6	7.6	7.4	7.2	7.0	6.9	6.8	6.6	6.4
Now under construction	3.2	3.2	3.5	4.7	6.0	5.2	4.9	6.1	6.0	5.2
Now on order/planned/future	0	0	0	0	1.2	2.8	3.9	4.6	4.0	8.0
Far East Subtotal	10.8	10.8	11.1	12.1	14.4	15.0	15.7	17.5	16.6	19.6
Other Free World[3]										
Reactors now operational	2.8	2.8	2.8	2.4	2.4	2.4	2.4	2.4	1.9	1.9
Now under construction	1.0	1.4	1.8	1.6	2.2	3.8	3.6	3.1	3.2	3.2
Now on order/planned/future	0	0	0	0	0	1.2	0.9	1.0	2.0	2.4
Other Subtotal	3.8	4.2	4.6	4.0	4.6	7.4	6.9	6.5	7.1	7.5
FREE WORLD[3] TOTAL	63.4	73.9	82.9	90.7	94.4	100.4	106.9	105.1	106.3	109.9
Worldwide Breakdown by Status										
Reactors now operational	50.5	50.8	50.8	49.9	49.4	48.7	47.9	47.3	46.2	45.0
Now under construction	12.9	23.1	32.1	40.8	43.8	46.4	51.6	48.0	48.2	47.0
Now on order/planned/future	0	0	0	0	1.2	5.3	7.4	9.8	11.9	17.9

[1]Computed quantities of U_3O_8 which would be used under the given conditions to fabricate fuel for loading and reloading reactors operational, under construction, on order, or forecasted as of September 30, 1982. Compiled and computed on a reactor by reactor basis, quantities for each reactor are based on specific core characteristics, 0.25% tails assay, no recycling, 24-month lead time for procuring first cores and 18-month lead time for procuring each reload. Estimates reflect annual consumption displaced in time to the start of the conversion-enrichment-fabrication cycle for timely loading into the reactor; they do not reflect refueling cycles.

[2]Japan, Korea, Taiwan, Philippines

[3]Excludes Bulgaria, Czechoslovakia, German Democratic Republic, Finland (two Russian reactors), Hungary, People's Republic of China, Poland, Romania, USSR

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Table 4

UNFILLED REQUIREMENTS
(Millions of Pounds U_3O_8, Equivalent)

	1983	1984	1985	1986	1987	1988	1989	1990	1991
Europe	0.8	1.0	1.0	2.0	3.2	5.5	5.3	9.3	10.1
Far East	0	0	0	0.1	0	1.0	3.0	1.8	3.2
Other Nations (ex-US)	1.7	1.7	2.6	1.2	1.0	1.9	0.9	1.2	1.2
SUBTOTAL Non-US	2.5	2.7	3.6	3.3	4.2	8.4	9.2	12.3	14.5
United States	3.2	9.0	9.3	19.7	17.7	20.5	23.1	24.4	22.8
TOTAL Free World	5.7	11.7	12.9	23.0	21.9	28.9	32.3	36.7	37.3

Table 5

SUPPLY-DEMAND BALANCE: US
[ONE AND ONE-HALF YEARS' DESIRED RELATIVE INVENTORY]
(Millions of Pounds U_3O_8 Equivalent)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Production[1]	25.9	14.7	12.0	12.4	12.3	12.0	12.4	12.6	13.4	16.9
less										
Consumption[2]	20.9	24.6	30.7	31.6	33.5	35.3	39.4	34.7	35.7	34.7
plus										
Net Imports/(Exports)[3]	3.5	6.0	3.0	1.7	1.9	1.9	2.3	2.4	2.4	2.4
equals										
Supply Surplus/(Deficit)	8.5	(3.9)	(15.7)	(17.5)	(19.3)	(21.4)	(24.7)	(19.7)	(19.9)	(15.4)
plus										
Beginning Inventory	138.8[4]	147.3	143.4	127.7	110.2	90.9	69.5	56.8	52.6	53.1
equals										
Nominal Inventory	147.3	143.4	127.7	110.2	90.9	69.5	44.8	37.1	32.7	37.7
less										
Minimum Inventory	33.2	40.0	46.5	48.4	51.2	55.0	56.8	52.6	53.1	52.2
equals										
Excess Inventory/ (Unfilled Demand)	114.1	103.4	81.2	61.8	39.7	14.5	(12.0)	(15.5)	(20.4)	(14.5)
Adjusted Ending Inventory	147.3	143.4	127.7	110.2	90.9	69.5	56.8	52.6	53.1	52.2
Relative Inventory (years)[5]	4.9	4.8	4.3	3.7	3.1	2.5	1.9	1.5	1.5	1.5

[1]Report 172, Table 3
[2]Report 173, Table 9
[3]Report 173, Table 16
[4]Commercial inventory only. Nuexco Report 170, page 19, Table 3
[5]For each year, Relative Inventory equals the number of years of forward consumption which could be supplied by that year's Beginning Inventory.

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Table 6

SUPPLY-DEMAND BALANCE: EUROPE
[THREE YEARS' DESIRED RELATIVE INVENTORY]
(Millions of Pounds U_3O_8 Equivalent)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Production	6.6	6.7	6.7	7.4	8.1	8.1	8.1	8.1	8.1	7.7
less										
Consumption	27.9	34.3	36.5	43.0	41.9	42.7	44.9	46.4	46.9	48.1
plus										
Net Imports	34.2	34.8	34.3	34.1	34.9	28.8	28.9	23.1	23.0	22.1
equals										
Supply Surplus/(Deficit)	12.9	7.2	4.5	(1.5)	1.1	(5.8)	(7.9)	(15.2)	(15.8)	(18.3)
plus										
Beginning Inventory	108.7[1]	121.6	128.8	133.3	131.8	132.9	134.0	138.2	141.4	146.5
equals										
Nominal Inventory	121.6	128.8	133.3	131.8	132.9	127.1	126.1	123.0	125.6	128.2
less										
Minimum Inventory	98.7	113.8	121.4	127.6	129.5	134.0	138.2	141.4	146.5	154.6
equals										
Excess Inventory/ (Unfilled Demand)	22.9	15.0	11.9	4.2	3.4	(6.9)	(12.1)	(18.4)	(20.9)	(26.4)
Adjusted Ending Inventory	121.6	128.8	133.3	131.8	132.9	134.0	138.2	141.4	146.5	154.6
Relative Inventory (years)[5]	3.5	3.4	3.3	3.1	3.1	3.0	3.0	3.0	3.0	3.0

[1]Nuexco estimate — commercial inventory only

Table 7

SUPPLY-DEMAND BALANCE: FAR EAST
[FIVE YEARS' DESIRED RELATIVE INVENTORY]
(Millions of Pounds U_3O_8 Equivalent)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Imports	22.4	24.9	21.6	26.0	22.7	20.3	19.9	18.7	18.5	18.5
less										
Consumption	10.8	10.8	11.1	12.1	14.5	15.0	15.7	17.5	16.6	19.7
equals										
Supply Surplus/(Deficit)	11.6	14.1	10.5	13.9	8.2	5.3	4.2	1.2	1.9	(1.2)
plus										
Beginning Inventory	77.6[1]	89.2	103.3	113.8	127.7	135.9	141.2	145.4	146.6	148.5
equals										
Nominal Inventory	89.2	103.3	113.8	127.7	135.9	141.2	145.4	146.6	148.5	147.3
less										
Minimum Inventory	59.3	63.5	68.4	74.8	79.3	84.5	86.5	90.5	94.7	98.2
equals										
Excess Inventory	29.9	39.8	45.4	52.9	56.6	56.7	58.9	56.1	53.8	49.1
Adjusted Ending Inventory	89.2	103.3	113.8	127.7	135.9	141.2	145.4	146.6	148.5	147.3
Relative Inventory (years)	6.2	6.6	7.0	7.2	7.6	7.7	7.7	7.6	7.4	7.2

[1]Nuexco estimate